LOOKING INTO THE BODY THROUGH THE EYE USING LASER LIGHT

Early Detection and Prevention of Diseases Long Before the Symptoms Appear

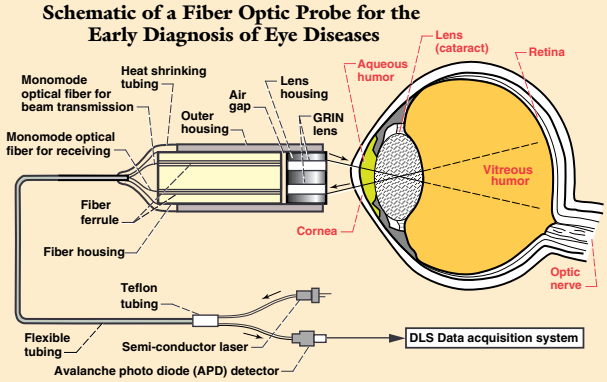
NCMR FLUIDS AND COMBUSTION

NASA Glenn Research Center

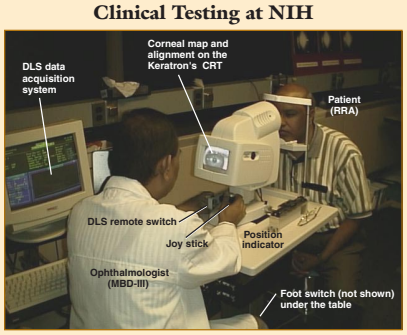
EYE "MICROCOSM OF THE BODY"

- Eye is built like a camera.
- Light from cornea to the retina traverses through tissues that are representative of nearly every tissue type in the body.
- **Cornea:** typical extra-cellular matrix composed primarily of collagen.
- **Aqueous:** an ultrafiltrate of blood, containing most of the molecules found in serum at concentrations that are reflective of serum levels.
- **Lens:** highly organized array of crystalline proteins.
- **Vitreous:** similar in nature to the articular cartilage and synovial fluid found in joints.
- **Retina and optic nerves** are in fact part of the central nervous system.
- Since eye is easily accessed by light, the optical technologies can be used for the evaluation of structure and physiology in health, aging, and disease.

Schematic of a Fiber Optic Probe for the Early Diagnosis of Eye Diseases



Clinical Testing at NIH



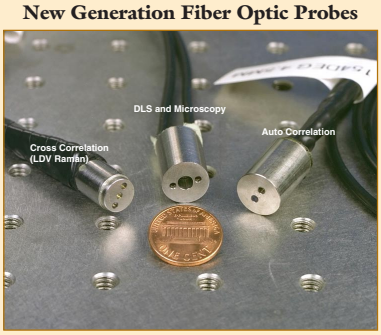
BLINDNESS DUE TO CATARACTS

- Worldwide, 50% of all blindness is due to cataracts
- No medical treatment
- 1.4 million cataract surgeries are performed each year in the U.S.
- $3.4 billion spent through Medicare
- 34 million Americans over the age of 65 have cataracts
- 70 million Americans will have cataracts in year 2030 compared to 34 million figure today

"A delay in cataract formation of about 10 years would reduce the prevalence of visually disabling cataracts by about 45%"

(Carl Kupfer, MD, Director NEI/NIH, The Conquest of Cataract: A Global Challenge, trans. Ophthal., Soc., UK, 1985)

New Generation Fiber Optic Probes

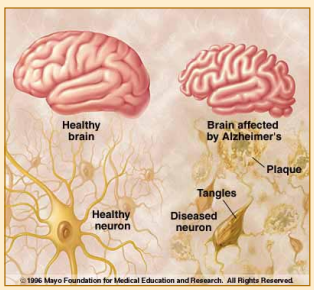


EARLY DETECTION OF ALZHEIMER'S THROUGH THE EYE LENS

Deposits of a protein called amyloid occur in the brain of people with Alzheimer's disease. At the moment the only sure way to diagnose Alzheimer's disease is at autopsy when brain tissue can be examined under a microscope.

- May be able to delay the Disease through treatments, such as anti-inflammatories, anti-oxidants, or hormone replacement therapy.

Collaboration (Harvard University/ Massachusetts General Hospital)



EARLY DETECTION OF AMD

(Age Related Macular Degeneration)

AMD damages and destroys the central vision of up to 1 in 3 Americans in their lifetime and has no known cause or cure.

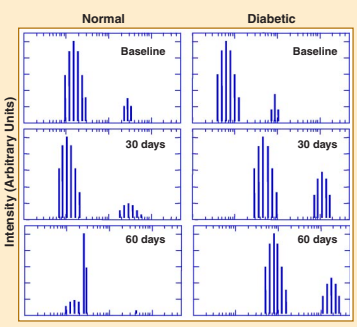
By the year 2025 the population of people over the age 65 in the U.S. will be 6 times higher than in 1990. AMD will soon take on aspects of an epidemic.

(Carl Kupfer, MD, Director NEI/NIH)

EARLY DETECTION OF DIABETES

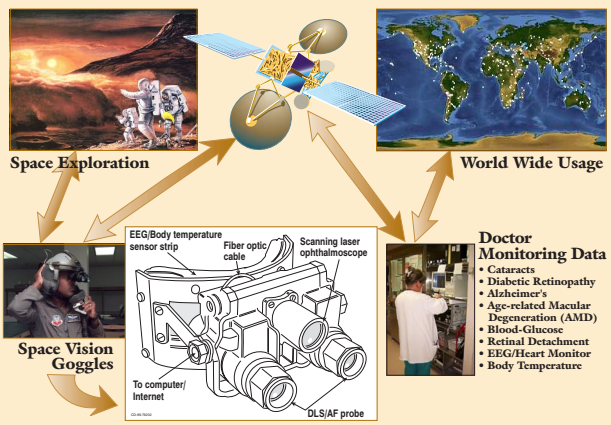
"Between the time you wake up this morning and the time you wake up tomorrow morning, there are going to be 2,000 people diagnosed with diabetes. There will be 150 amputations, about 70 people who go blind from diabetes, and approximately 75 people who enter end-stage disease programs because of diabetes."

(Frank Vinicor, MD, MPH, Director of the Division of Diabetes Translation, CDC)



Looking to the Future (Bio-Astronautics)

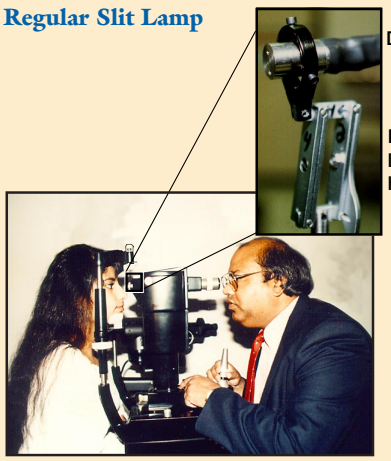
Ophthalmic Tele-Health: For the Benefit of All Human Kind



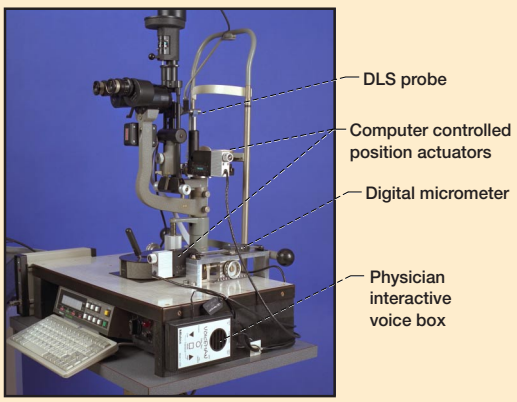
Contact: Dr. R.R. Ansari 216–433–5008
email: Rafat.R.Ansari@grc.nasa.gov

New Ophthalmic Instruments with Dynamic Light Scattering (DLS) Capabilities

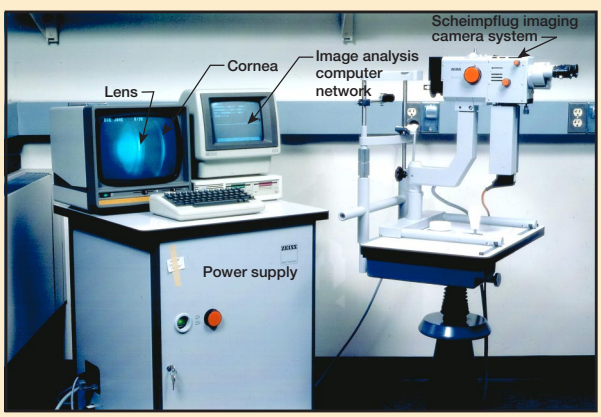
Regular Slit Lamp



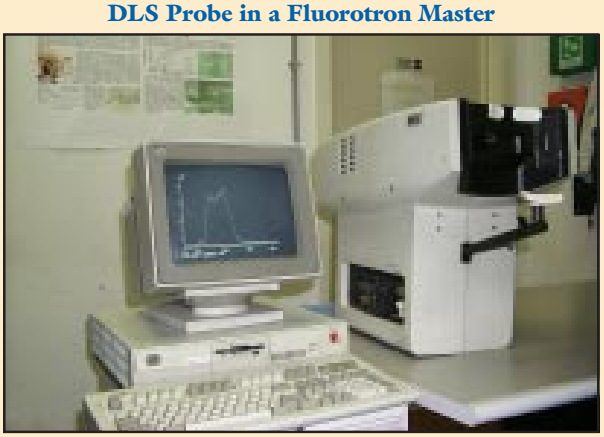
Automated Slit Lamp/DLS Apparatus



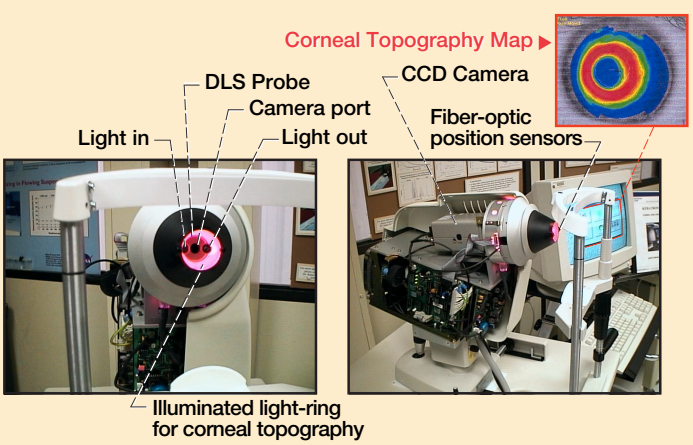
Zeiss Scheimpflug Imaging Set-up with DLS at NEI/NIH



DLS Probe in a Fluorotron Master



Modified Corneal Analyzer (Keratron) with DLS Probe



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Aim: Diagnose Diseases Non-Invasively Long Before Clinical Symptoms Appear

NASA developed compact fiber optic probes

Optical Technique	Disease	Potential Counter-measures	Collaborator (Status)
Dynamic Light Scattering (DLS)	Cataract	Anti-oxidants (red wine, green tea, Vitamins), Aldose Reductase Inhibitors, Pentethine, Sun glasses	NIH (Clinical First Phase completed) (Clinical Second Phase to begin soon)
	Radiation Damage	Better Protective Shields (Bio-Astronautics/ Bio-Informatics)	OaklandUniversity/(Animals)
	Diabetes Vitreopathy Uveitis Cholesterol Alzheimer's		FDA/(Animals) Doheny/(Cadavers) NIH/(Experimental)
	Environmental Toxicity	Anti-inflammatories, anti-oxidants, hormone replacement therapies Replace Animal (Draize) Testing	Harvard, Mass General, Brigham Womens (Animals) Drug/Consumer Products Testing (animal safety)
Corneal Auto-Fluorescence	Diabetic Retinopathy	Blood-glucose management	University of Brescia, Italy/Clinical
Laser Doppler Velocimetry (LDV)	Retinal Diseases (AMD) (Diabetic retinopathy)	Better optic nerve head & choroidal flow Diabetes control	Doheny Eye Institute (Experimental)
Raman	Age-related Macular Degeneration (AMD) Measure: Carotenoid Pigments	Luetin (spinach, broccoli, etc) and Zeaxanthin (peaches, corn, etc).	Doheny Eye Institute (Experimental)
Polarimetry	Diabetes	Blood-glucose monitoring (Better Compliance)	University of Brescia, (Experimental)

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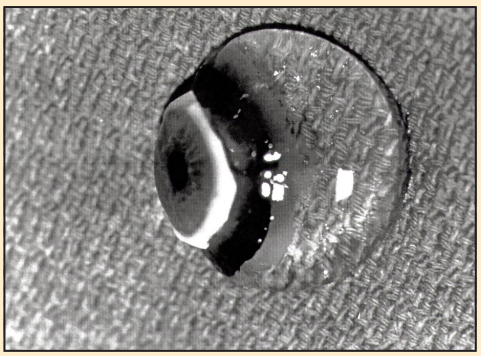
Vitreous in Disease and Aging

Vitreous of a 9-Month-Old Baby Boy



J. Sebag, Doheny Eye Clinic

Contact:
Rafat R. Ansari, Ph.D.
Phone: 216–433–5008
email: rafat.r.ansari@grc.nasa.gov

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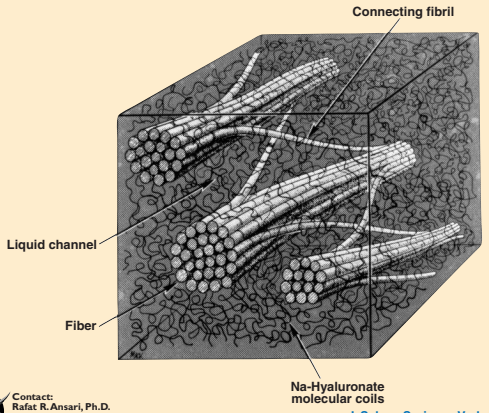
The Vitreous



J. Sebag, Springer-Verlag 1989

Contact:
Rafat R. Ansari, Ph.D.
Phone: 216–433–5008
email: rafat.r.ansari@grc.nasa.gov

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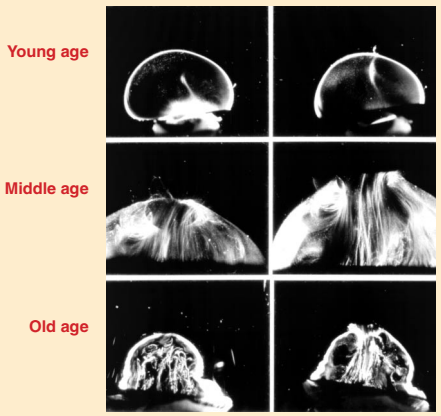

Contact:
Rafat R. Ansari, Ph.D.
Phone: 216–433–5008
email: rafat.r.ansari@grc.nasa.gov

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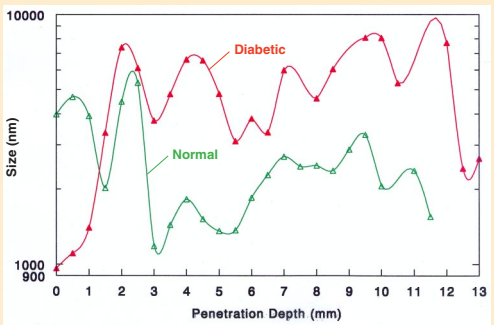
Contact:
Rafat R. Ansari, Ph.D.
Phone: 216–433–5008
email: rafat.r.ansari@grc.nasa.gov

Effects of Diabetes on Vitreous
Slow Component (Anterior-Posterior)



Contact:
Rafat R. Ansari, Ph.D.
Phone: 216–433–5008
email: rafat.r.ansari@grc.nasa.gov

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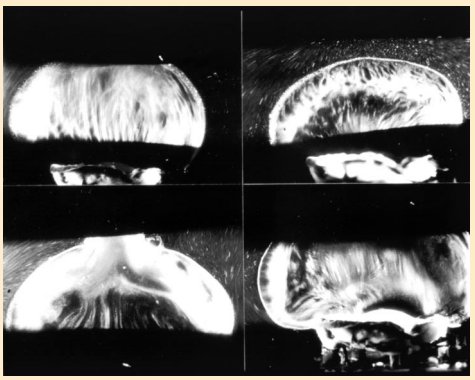
9-Year-Old Girl with a 5-Year-Old History of Diabetes



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Rafat R. Ansari, Ph.D.
Phone: 216–433–5008
email: rafat.r.ansari@grc.nasa.gov

80164
08-02-00

P-0084
09-19-00

1999-2000 Patent and Publications:

1. Fiber-optic Imaging Probe, U.S. Patent 5,973,779, October 26, 1999, Rafat R. Ansari and Kwang I. Suh.

2. R. R. Ansari and M. B. Datiles III, "Use of Dynamic Light Scattering and Scheimpflug Imaging for the Early Detection of Cataracts" Diabetes Technology & Therapeutics, Vol.2, Number 2, pp 159-168, 1999.

3. J. Sebag, R. R. Ansari, Stephan Dunker, and Kwang Suh, "Dynamic Light Scattering of Diabetic Vitreopathy" Diabetes Technology & Therapeutics, Vol.2, Number 2, pp 169-176, 1999.

4. F. Bettelheim, R. R. Ansari, Qiu-Fang Cheng, and J. S. Ziggler, "The Mode of Chaperoning of Dithiothreitol-Denatured a-Lactalbumin by a-Crystallin" Biomedical and Biophysical Research Communications, 261, 292-297, 1999.

5. R. R. Ansari, B. Singh, L. Rovati, F. Docchio, and J. Sebag, "Monitoring Astronaut Health at the Nanoscale Cellular Level Through the Eye" NASA/TM 2000-210041, April 2000.

6. R. R. Ansari, M. B. Datiles III, and J. F. King, "A New Clinical Instrument for the Early Detection of Cataract Using Dynamic Light Scattering and Corneal Topography" SPIE BiOS, Vol. 3908, 2000.

Acknowledgments:

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